Interview Summary	Application No.	Applicant(s)	
	09/588,407	BLACKMORE ET AL.	
	Examiner	Art Unit	
	Steven D. Maki	1733	

All participants (applicant, applicant's representative, PTO personnel):

(1) *Steven D. Maki*. (3) *Richard Blackmore*.

(2) *David McEwing*. (4)_____.

Date of Interview: *04 June 2004*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: *1-16 and 18-25 (see interview summary attachment A)*.

Identification of prior art discussed: *art of record*.

Agreement with respect to the claims f)☐ was reached. g)☒ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *See Continuation Sheet*.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Steven D Maki

Examiner's signature, if required

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)
In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Continuation of Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: Discussed combination of Davis et al and Hollingsworth. Discussed Davis et al's use of bladder to fabricate composite article and specific mandrel of Hollingsworth. Applicant noted that Hollingsworth has two step mandrel. Discussed rejection based on Japan '334. Examiner faxed a copy of a translation of Japan 2-150334 to applicant (see interview summary attachment B). Noted that fibers in Japan '334 are crimped. Examiner confirmed that claims 7-11 and 23-25 are directed to a non-elected invention.

INTERVIEW SUMMARY ATTACHMENT A

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Firm: USPTO

FAX No. 571.273.1221

Number of Pages (including cover) 6

DATE: June 3, 2004

RE: 09/588407 Filed 12/10/2000
Inflatable Heating Device

GAU 1773

COMMENTS: Mr. Maki: I have attempted to reconstruct how the claims should have been presented in the Response to the October 9, 2003. I am offering it now as a draft as a possible tool to make our telephone conference more productive. I will call you at 2 PM EST today (Friday).

09/588407
6/4/2004

Draft

1. (Currently Amended) An inflatable heating device comprising:
a generally cylindrical body having an inner surface and an outer surface, said inner surface of said cylindrical body of the heating device defining a generally hollow inflation chamber, said body including a flexible matrix and a plurality of nonmetallic, electrically conductive fibers embedded within said flexible matrix, said flexible matrix being cured to a stable elastomeric state by electrical resistive heating of said fibers, said body being capable of expanding and returning to an original form, and electrical cable lines connecting the electrically conductive fibers in the generally cylindrical body to an electrical energy source for providing electrical energy to the electrically conductive fibers to resistively heat the electrically conductive fibers.

2. (Original) The inflatable heating device of claim 1 wherein said flexible matrix comprises fluorosilicone.

3. (Previously Amended) The inflatable heating device of claim 1 wherein said fibers are carbon fibers.

4. (Original) The inflatable heating device of claim 1 wherein said carbon fibers are angled at an angle of +/- 45° with respect to said longitudinal axis of said body.

5. (Original) The inflatable heating device of claim 4 wherein said carbon fibers are arranged in one of tows and bundles to provide approximately 50-90% coverage of said body.

6. (Previously Presented) The inflatable heating device of claim 1 wherein said carbon fibers are in the form of a non-woven tape.

7. (Withdrawn)

8. (Withdrawn)

9. (Withdrawn)

10. (Withdrawn)

11. (Withdrawn)

12. (Currently Amended) An apparatus for curing a heat curable resin of a pre-preg repair material supporting a heat curable resin for in-situ repair of a conduit, comprising:

an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element disposed within a thermoset resin matrix;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port for communication between the non-ferrous heating element and ~~to convey electric current to the non-ferrous heating element from for communication with~~ a power supply source; and

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece, and the second end piece form ~~an~~ a generally hollow inflation chamber.

13. (Original) The apparatus of Claim 12 wherein the thermoset resin of the elastomeric composite is selected from the group consisting of fluorocarbon and fluorosilicone.

14. (Original) The apparatus of Claim 12 wherein the heating element includes a plurality of braided fibers comprising of temperature tolerant fiber braids and electrically conductive fiber braids.

15. (Original) The apparatus of Claim 14 wherein the braided fibers interact to define a braid angle measure at +/- 45 degrees.

16. (Original) The apparatus of Claim 14 wherein the electrically conductive fiber braids are carbon filaments.

17. Deleted

18. (Original) The apparatus of Claim 12 wherein the heating element includes a plurality of wound fibers comprising of temperature tolerant fiber windings and electrically conductive fiber windings.

19. (Original) The apparatus of Claim 18 wherein the wound fibers interact to define and angle measure at +/- 45 degrees.

20. (Original) A method for repairing a damaged section of a conduit comprising the steps of:

providing an elastomeric composite having a first and second end, wherein the composite includes a heating element disposed within a thermoset resin matrix;

fixedly attaching a first and second end piece respectively to the first and second ends of the composite, wherein the first end piece. the second end piece, and the composite form a heating/inflation module;

removably attaching a pre-preg to an outer surface of the composite, wherein the pre-preg includes a structural fiber matrix supporting a heat curable resin;

positioning the module with the attached pre-preg into the conduit at a damaged location;

inflating the module to a predetermined internal air pressure to expand the composite and press the pre-preg against an inside surface of the conduit;

curing the resin of the pre-preg by causing an electrical current to flow in the heating element to resistively heat the module to a predetermined temperature; and

deflating the module and removing it from the conduit.

21. (Currently Amended) An inflatable heating device comprising:

a generally cylindrical body having an inner surface and an outer surface, said inner surface of said cylindrical body of the heating device defining a generally hollow inflation chamber, said body comprising a thermoset resin matrix and a plurality of carbon fibers embedded within said matrix, said carbon fibers being arranged helically and positioned at an angle of +/- 45 degrees with respect to the longitudinal axis of said body, said matrix being cured to a stable elastomeric state by electrical resistive heating of said carbon fibers, said body being capable of expanding and returning to an original form, and electrical cable lines

connecting the carbon fibers in the generally cylindrical body to an electrical energy source for providing electrical energy to the carbon fibers to resistively heat the carbon fibers.

22. (Currently Amended) A system for in-situ repair of a conduit, comprising:

an apparatus including an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element disposed within a thermoset resin matrix;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port to convey electric current to the non-ferrous heating element from ~~for communication~~ with a power supply source;

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece. and the second end piece form an inflation chamber; and,

a pre-preg removably attached to an outer surface of the composite of the apparatus, the pre-preg including a structural fiber matrix supporting a heat curable resin.

23. (Withdrawn)

24. (Withdrawn)

25. (Withdrawn)

26. (New) An inflatable heating device having a generally cylindrical body for internal in-situ repair of pipe shaped objects comprising:

an elastomeric seamless composite closed body having a generally cylindrical shape formed of at least one layer of a flexible elastomeric material having a first inner surface and a second outer surface, a plurality of nonmetallic, electrically conductive fibers located substantially throughout the length of the cylindrical shaped body between the first inner surface and second outer surface of the flexible elastomeric material;

at least one electrically conductive cable port connecting the electrically conductive fibers to an electrical power source; and

at least one air port for inflation and deflation of the closed body.

27. (New) The inflatable heating device of Claim 26 wherein the generally cylindrical body has an outer diameter sized to allow the second outer surface to contact an inner surface of a repair object to transfer electrical resistive heat energy created by the conductive fibers located between the first inner surface layer and second outer surface layer when energized by the electrical power source and the body is inflated.

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Firm: USPTO

FAX No. 703.872.9606

Number of Pages (including cover)

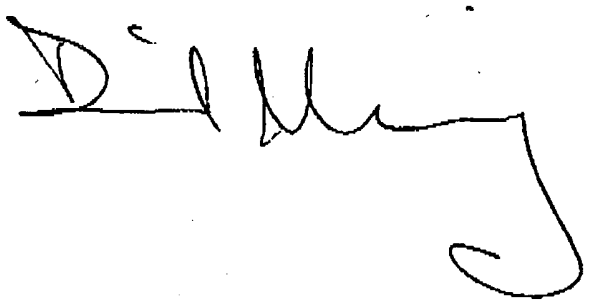
DATE: June 3, 2004

RE: 09/588407 Filed 12/10/2000
Inflatable Heating Device

GAU 1773

COMMENTS: Revocation of Power of Attorney with New Power of Attorney and Change of Correspondence Address

Cc: Steven Maki 571.273.1221



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REVOCATION OF POWER OF ATTORNEY WITH NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	09/588,407
Filing Date	December 10, 2000
First Named Inventor	Richard Blackmore
Art Unit	1733
Examiner Name	Steven Maki
Attorney Docket Number	240-P-028

I hereby revoke all previous powers of attorney given in the above-identified application.

☐ A Power of Attorney is submitted herewith.

OR

☑ I hereby appoint the practitioners associated with the Customer Number: 26328 ~~28038~~

☑ Please change the correspondence address for the above-identified application to:

☐ The address associated with Customer Number: 26328 ~~28038~~

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I am the:

☑ Applicant/Inventor.

☐ Assignee of record of the entire interest. See 37 CFR 3.71.
Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record

Name	Richard Blackmore		
Signature	Richard Blackmore		
Date	April 26, 2004	Telephone	(281) 893-0720

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.36. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

INTERVIEW SUMMARY ATTACHMENT B

PTO 04-0398

CY=JA DATE=19900608 KIND=A
PN=02-150334

DEVICE FOR PARTIALLY REPAIRING PIPELINE FROM INSIDE
[Kanro wo sono naimen kara bubunhoshuu suru souchi]

Kunihiro Mori, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. November 2003

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APPLICANTS (71): TOKYO GAS CO., LTD.; ASHIMORI INDUSTRY CO., LTD.

TITLE (54): DEVICE FOR PARTIALLY REPAIRING PIPELINE FROM INSIDE

FOREIGN TITLE (54A): KANRO WO SONO NAIMEN KARA BUBUNHOSHUU SURU SOUCHI

SPECIFICATION /195*

1. Title of the Invention

Device for Partially Repairing Pipeline from Inside

2. Claims

1. A device that partially repairs a pipeline from the inside and in which an expandable body that generates heat when energized and that is made of a material that has air-tight properties is mounted over the surface of the hollow main unit of a repairing tool that can be inserted into a pipeline, in which both ends of this expandable body are connected to said main unit of the repairing tool to create an air-tight space between the main unit of the repairing tool and the expandable body, and in which an operating liquid passage that is for pressure-feeding a liquid into and discharging the liquid from the air-tight space is structured on the main unit side of the repairing tool.

2. A device of Claim 1 that partially repairs a pipeline from the inside characterized by the expandable body being a cloth body woven by using crimped threads, by an air-tight layer made of rubber or an elastic resin being created on the inner surface of the cloth body, and by applying a paint that generates heat when energized onto said cloth body or by impregnating said cloth body with the paint.

3. A device of Claim 1 that partially repairs a pipeline from the inside characterized by the expandable body being a knitted cloth body, by an air-tight layer made of rubber or an elastic resin being created on the inner surface of the cloth body, and by applying a paint that generates heat when energized onto said cloth body or by impregnating

* Numbers in the margin indicate pagination in the foreign text.

said cloth body with the paint.

4. A device of Claim 1 that partially repairs a pipeline from the inside characterized by having a structure in which a cloth body, which is the expandable body, provided with an air-tight layer made of rubber or an elastic resin on its inner side is woven or knitted by using threads that generate heat when energized.

3. Detailed Explanation of the Invention

[Field of Industrial Application]

The present invention pertains to devices that partially repair pipelines that are buried underground, such as gas piping, water pipes, etc., from the inside.

[Prior Art]

As a repairing method utilized when a leakage source, such as partial corrosion, occurs in a gas pipeline, etc., a method (Kokai No.58-17278) in which it is repaired by placing a repairing material against the inner surface of the pipeline is commonly known.

This commonly known example is a repairing method in which an adhesive is sprayed onto the location on the inside surface of a pipeline that needs to be repaired to form an adhesive layer and in which a softened ring-shaped thermosetting repairing material is adhered after expanding the diameter.

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In the above repairing method, the device shown in Figure 6 is utilized.

In Fig. 6, [101] is a ring-like rubber plate, and its ends are fixated to side plates, [102] and [102']. One [102] of the side plates is provided

with an outlet for a hot-air pipe [103] so that hot air will be sprayed onto the outer periphery of the rubber plate [101] and is also connected to the front end of a compressed-air pipe [104] so that compressed air can be injected into the rubber plate [101].

Thus, the above-described repairing material [105] is attached onto the outer periphery of the rubber plate [101], the repairing material [105] becomes softened by the hot air jetted out of the hot-air pipe [103], and the repairing material [105] becomes expanded in the diametrical direction by the compressed air injected form the compressed air pipe [104].

[Problems that is to be Solved]

However, since hot air is utilized to soften the repairing material, this commonly known example has the following problems.

The heat source of the hot air is generated above ground and is then guided to the repairing location through the pipe. Therefore, the heat source and the repairing location are separated, and the temperature drops before the hot air reaches the repairing location. Therefore, the softening of the repairing material takes time.

Moreover, when the repairing material is expanded in the diametrical direction and is adhered to the pipe's inner surface in the commonly known example, the hot air does not reach the adhesive layer after that, and the hardening of the adhesive cannot be hastened by heating. Therefore, the repairing material needs to be pressured against the pipe's inner surface for a long time until the adhesive becomes hardened naturally.

Moreover, since hot air does not reach even the repairing material after the repairing material is adhered to the pipe's inner surface by

having its diameter expanded, solidification of the repairing material starts and the repairing material cannot be kept sufficiently pressured against the pipe's inner surface. For this reason, there is a risk of a gap being created between the pipeline's inner surface and the repairing material after the repair is finished. Moreover, there is a hot-air temperature gradient between the vicinity of the output of the hot-air pipe and its opposite side, and heating cannot be performed evenly in the circumferential direction.

The present invention is proposed in light of the above problems, and its purpose is to propose a device that partially repairs the pipeline from its inner surface and that is capable of expeditious and reliable repairing operations using repairing materials.

[Means for Solving the Problems]

In the present invention, a device having the following structure is proposed as a means for solving the above-mentioned problems.

An expandable body that generates heat when energized and that is made of a material that has air-tight properties is mounted over the surface of the hollow main unit of a repairing tool that can be inserted into a pipeline, both ends of this expandable body are connected to said main unit of the repairing tool to create an air-tight space between the main unit of the repairing tool and the expandable body, and an operating liquid passage, which is for pressure-feeding a liquid into and discharging the liquid from the air-tight space, is structured on the main unit side of the repairing tool. Thus, the device repairs the pipeline from its inside.

In the above device, the expandable body that generates heat when energized is a fabric body woven with crimped threads. It is permissible

to structure an air-tight layer that is made of rubber or an expandable resin on the inner surface of this fabric body and to then have a paint that generates heat when energized applied to or impregnated in said fabric body.

An example of the paint that generates heat when energized is one obtained by admixing 50~60 parts of graft-polymerized acetylene black to an urethane resin, which will be the medium resin, by kneading the mixture, and by then dissolving it in methylethylketone.

This heat-generating paint may be applied to the surface of the fabric body by using a brush or may be sprayed onto it by means of a gun. Note, however, that the homogenization of the application needs much caution since the heat becomes locally excessive or insufficient unless it is homogeneous over the entire surface.

Next, as for the means of impregnation, the fabric body may be directly immersed in the heat-generating paint or the fabric body may be woven by using threads that have been immersed.

The fabric body must have expandability, and for this, crimped threads may be utilized as mentioned earlier, or expandability may be provided to the fabric body by weaving threads.

Next, as the means for allowing the expandable body to generate heat, a method in which a heat-generating paint is applied to or impregnated in the fabric body as mentioned earlier and a method in which the fabric body is made by knitting or weaving threads which themselves generate heat are conceivable.

Examples of such heat-generating threads are ones that are obtained by inserting carbon-type heat-generating bodies into the cores of

expandable resin threads, organic fiber yarns containing conductive particles, etc. /197

[Operation of the Invention]

In the above device, a repairing sleeve is first attached onto the outside of the expandable body of the repairing tool's main unit, an adhesive is then applied to the outside surface of the repairing sleeve, and the repairing tool's main unit (repairing device) is inserted into the pipe to the repairing location by using an inserting body. Next, an operating liquid is pressured into the air-tight space, the expandable body and the repairing sleeve provided on the outside of it are expanded in the diametrical direction, and the repairing sleeve is adhered tightly to the repairing location.

Next, the expandable body is made to generate heat by energizing this expandable body by means of a power feeding device, and the adhesive is heated through the repairing sleeve until it becomes gelatinized. After this condition is achieved, the power feeding is stopped to solidify the adhesive. This solidification may be carried out by waiting for natural cooling to occur or forcibly by, for example, injecting a coolant into the air-tight space.

After the repairing sleeve becomes completely attached to the repairing location, the expandable body is made to shrink in the diametrical direction by discharging the operating liquid from the air-tight space, and the operation is then finished by pulling the repairing tool's main unit to the outside of the pipe.

[Working Example and Operation]

A working example of the device of the present invention will be explained below based on Figs. 1~5.

The reference numeral [1] is the repairing tool's main unit. This main unit [1] has a through-hole [2] that runs from an inlet [2'] to an outlet [2''] on the inside and has a structure in which a wheel [3] is attached to the front and the rear by means of a spring [3''] via a wheel arm [3'] that can operate in the radial direction.

[4] is an expandable body. Both ends, [5] and [5'], of this expandable body [4] are fixated on the outer periphery of the trunk part [1'] of said main unit [1] to form an air-tight space [4'] with the trunk part [1'] of the main unit [1].

The expandable body [4] is made up of an inner-surface air-tight layer [6] that consists of an elastic resin or rubber and a cylindrical cloth [7] made by using crimped threads.

On both ends of the cylindrical cloth [7], metallic tapes, [8] and [8'], are wrapped around and fixated to the outside periphery. These metallic tapes, [8] and [8'], have electricity fed to them from a power feeding device (not illustrated) via the power lines [9] of a cathode and an anode, respectively. Incidentally, for the cylindrical cloth [7], covered yarns obtained by wrapping crimped threads of polyethylene terephthalate around crimped threads of polyurethane are utilized for the weft and crimped threads of polyethylene terephthalate are utilized for the warp. This cylindrical cloth [7] is obtained by impregnating it with the following heat-generating paint and by then drying it.

The heat-generating paint was obtained by admixing 50~60 parts of graft-polymerized acetylene black to a urethane resin that would become

the medium resin, by kneading the mixture, and by then dissolving it in methylethylketone.

Metallic-powder-type and carbon-type are conceivable as the conductive additive of the heat-generating paint, but the carbon-type is preferred in terms of the workability, cost, and controllability and graft-polymerized acetylene black is the best of all. Since this graft-polymerized acetylene black has excellent dispersibility in a medium and can therefore be attached to the processed threads evenly, a homogeneous resistor can be attained, and passing current will not flow and heat locally. Therefore, it is very safe without a risk of combustion.

As for said cylindrical cloth [7], it may instead be obtained by impregnating crimped threads with said heat-generating paint in advance and by then drying it and shaping it into a cylinder. Or it may be obtained by crimping an organic fiber yarn that contains conductive particles and by then shaping it into a cylinder.

[10] is a pressure injecting hole for the operating liquid. This liquid pressure injecting hole [10] is provided in the air-tight space [4'] created between the trunk part [1'] of said main unit [1] and the expandable body [4], and this injection hole [10] is connected to a compressor (not illustrated) via a liquid pressure conduit [11].

[12] in the figure is an inserting body that is connected to one end of said main unit [1] by means of a coupling [13].

Next, a repairing example in which the device of the above working example is utilized will be explained.

As shown in Fig. 3, it will be assumed that a pinhole [15] has occurred in one part of the pipeline [14].

First, a thermosetting repairing sleeve [16] having a diameter smaller than that of the inner diameter of the pipeline [14] is attached to the outside of the expandable body [4] of the repairing device.

Next, an adhesive [18] is applied to the outer surface of the repairing sleeve [16] and a small internal pressure is applied to the air-tight space [4'] inside the expandable body [4] in order to keep this repairing sleeve [16] from coming off of the expandable body [4]. /198

Next, a work hole is drilled and is cut with the pipeline [14] exposed inside the hole. From the inlet that the cutting made, a repairing device is inserted by using an inserting body [12]. The repairing device moves inside the pipeline [14] smoothly by means of the wheels [3].

After confirming that the repairing device has been inserted to reach the location of the pinhole [15], the insertion of the device is stopped. This condition is shown in Fig. 3. The repairing location [15] has been detected in advance, and the repairing device is inserted based on this data.

After that, a liquid-pressure operating liquid is fed to the air-tight space [4'] inside the expandable body [4] through the liquid pressure conduit [11] and injection hole [10] to expand the expandable body [4]. In this case, the cylindrical cloth [7] can expand or shrink together with the air-tight layer [6] since it is made of crimped threads. For this reason, the expandable body [4] expands evenly in the longitudinal direction. Then the repairing sleeve [16] attached to the outside of the expandable body [4] is also evenly expanded in the longitudinal direction and eventually becomes closely attached to the pinhole [15] location on

the inner surface of the pipeline [14].

Next, voltage is applied to the electrodes of the metallic tapes, [8] and [8'], located on both ends of the cylindrical cloth [7] from a power feeding device through an electrical wire [9] to allow the cylindrical cloth [7] to generate heat. As the temperature of the cylindrical cloth [7] starts rising, the adhesive [18] of the repairing sleeve [16], which is located on the outside, becomes heated.

The adhesive [18] is heated by the heat generated by the cylindrical cloth [7] for a period of time longer than the gelation time of the adhesive [18].

After the gelation time of the adhesive [18] has been exceeded, the heat generation is stopped by stopping the power feeding to the cylindrical cloth [7], and the hardness of the adhesive [18] of the repairing sleeve [16] is increased by cooling it by natural cooling or by another forcible cooling means. This condition is shown in Fig. 4.

After cooling is completed, the liquid pressure is discharged from the air-tight space [4'], which is inside the expandable body [4], through the liquid pressure conduit [11] to shrink the expandable body [4] in the diametrical direction.

After closely adhering the repairing sleeve [16] to the pinhole [15] on the inner surface of the pipeline [14] and shrinking the expandable body [4] in the diametrical direction as mentioned earlier, the repairing device is collected from inside the pipeline [14] to finish the repairing operation.

The condition in which the pinhole [15] has been repaired by means

of the repairing sleeve [16] is illustrated in Fig. 5.

Moreover, in order to prevent the adhesive [18] applied to the repairing sleeve [16] from drooping down, it is preferred that the outer periphery of the repairing sleeve [16] be wrapped with the cloth [17] and that the cloth [17] be impregnated with the adhesive [18] in advance.

Moreover, the following may instead be utilized as the repairing sleeve: the article that the applicant utilized in the earlier application Tokugan No.63-107991 and that is obtained by attaching a sealing material on the outer periphery of a pipe-shaped low-melting-point crystalline shape memory resin; or a thermosetting glass fiber reinforced plastic that is a gel at room temperature.

In the case of the former shape memory resin, the repairing operation will be similar to that mentioned earlier. The repairing device is inserted until the repairing location is reached, power is fed from the power feeding device to allow the cylindrical cloth [7] to generate heat, the shape memory resin is heated to a temperature near the melting point in order to make it easy for it to expand in the diametrical direction, and liquid pressure is then fed into the expandable body [4] by means of a compressor to expand the expandable body [4] and to attach it tightly to the pinhole [15] location.

[Effects of the Present Invention]

In this manner, according to the device of the present invention, the expandable body itself heats up when energized, and therefore, the repairing sleeve can be heated directly and the repairing sleeve can be quickly softened efficiently and evenly regardless of the distance between the repairing location and the cutting inlet of the pipeline.

Moreover, since the expandable body can be heated while expanding the repairing sleeve in the diametrical direction, the degree of adhesion to the pipe's inner surface can be increased even more. Therefore, the repairing sleeve will not peel off after the adhesive is cured.

Next, since the main unit of the inserting tool for the repairing device is hollow, a repairing operation in an active pipe is possible.

4. Brief Explanation of the Drawings

Figure 1 is a vertical cross-sectional drawing of the repairing device pertaining to the present invention, Figure 2 is a cross-sectional drawing of the line a-a', Figure 3 is a vertical cross-sectional drawing of a condition in which the repairing device has been inserted until it has reached the repairing location, Figure 4 is a vertical cross-sectional drawing of a condition in which the repairing sleeve has been expanded in the diametrical direction by expanding the expandable body in order to attach it closely to the inner surface of the pipe, Figure 5 is a vertical cross-sectional drawing of the repairing location that shows the repair-complete condition, and Figure 6 is an explanatory drawing of a commonly known example.

[1] = inserting tool's main unit; [4] = expandable body; /199 [6] = liquid pressure injecting hole; [7] = cylindrical cloth; [16] = repairing sleeve.

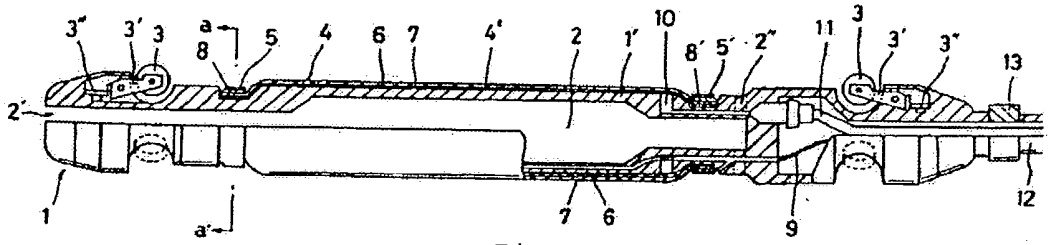


Figure 1

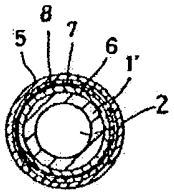


Figure 2

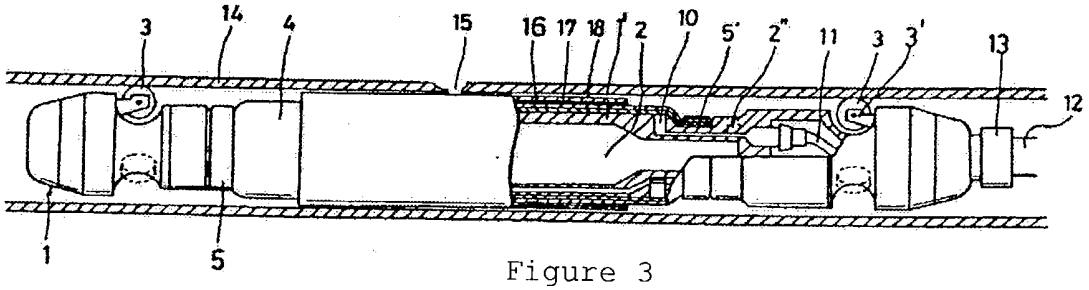
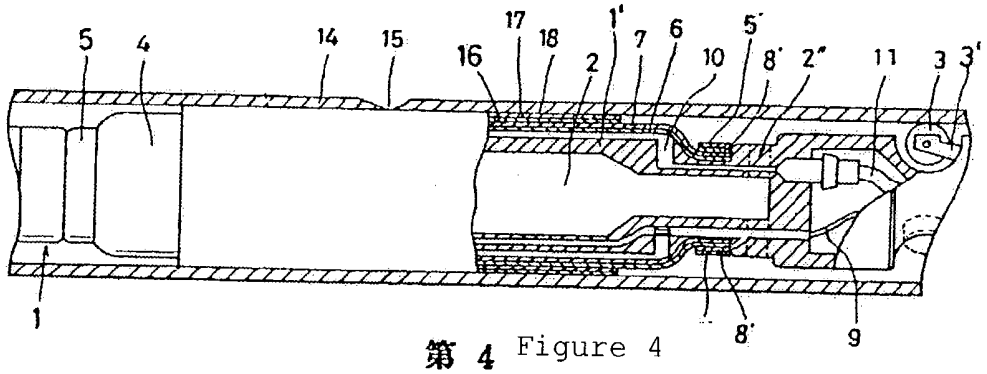


Figure 3



第 4 Figure 4

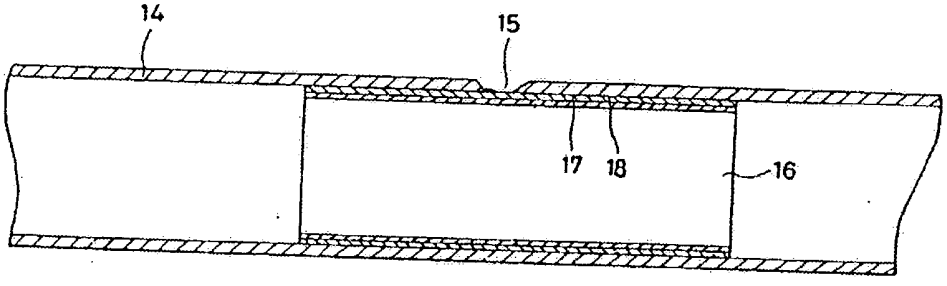


Figure 5

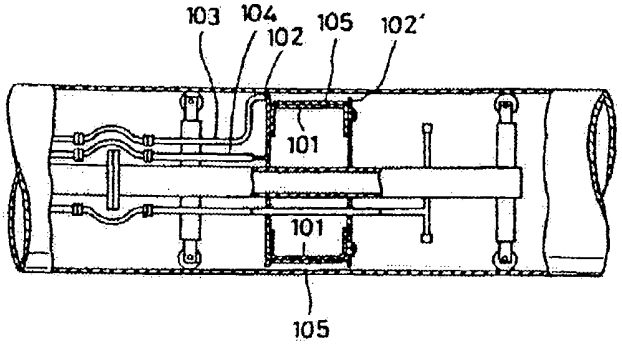


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Figure 6